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MOUNTAINEERING EQUIPMENT EVALUATION

Joseph C. Labelle

Arctic Institute of North America

Prepared for:

Army Natick Laboratories

October 1972

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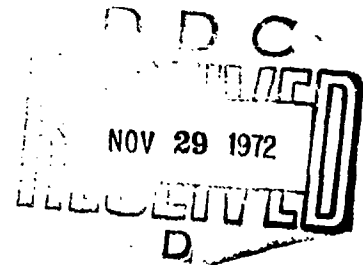
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Joseph C. LaBelle

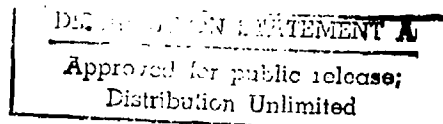
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Arctic Institute of North America
Washington, D. C.

Submitted under P.O. No. DAA17-72-M-2362
U. S. Army Natick Laboratories

Details of illustrations in
this document may be better
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October 30, 1972

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MOUNTAINEERING EQUIPMENT EVALUATION

by

Joseph C. LaBelle

Introduction

Pursuant to a request from the U. S. Army Natick Laboratories, Purchase Order No. DAA17-72-M-2362, the Arctic Institute of North America carried out testing and evaluation of certain commercially available mountaineering equipment, considered by the project investigator to be the best available on the commercial market today. This equipment was tested under varying climatic conditions and extremes in the St. Elias Mountains of the southwestern Yukon Territory, Canada. Tests were carried out in the low altitude (2600 ft.) forested region near Kluane Lake, in the medium altitude (10,000 ft.) alpine environment of the central St. Elias Mountains, and in the severe high altitude (up to 19,850 ft.) polar environment of Canada's highest mountain, Mt. Logan.

The tests described were chiefly carried out during the month of July, 1972, though extensive experience from previous years was made use of. Equipment was tested in the process of glacier exploration and high mountain climbing, of varying degrees of technical difficulty. Evaluation was based on the knowledge that the soldier, not the recreational mountaineer, will be the beneficiary of the tests. The foot soldier at war often has quite different equipment requirements from the civilian mountaineer out for a holiday.

Before the field evaluation program, consultations were held by the project investigator, J. C. LaBelle, with Mr. Theodore Bailey, Mr. Eldon Metzger, and Mr. Douglas Swain of the Natick Laboratories.

Requirements, types and brands of equipment, and certain testing and evaluation parameters were discussed and incorporated in the program. In most cases, two or more commercial brands of equipment were evaluated; in some cases Natick indicated interest in only one brand, to be evaluated for deficiencies.

In the following report, recommendations are based on the "best available" commercial product, with suggested alterations or modifications, where applicable, that should be incorporated for Army use. In some cases, equipment can be purchased "off the shelf"; in others the Army may find it necessary or desirable to contract the manufacturer to make modified equipment to fit Army standards.

Ski Bindings

Over the years this investigator has tried many commercially available types of ski bindings for cross country skiing and ski mountaineering. In this day of extensive use of the outdoors for recreation, many types of bindings have evolved which are specialized for either downhill or cross country skiing. Though these work well in their specific environment, few have been designed that can be used effectively in a number of conditions. Downhill bindings must be stiff for control, have a safety breakaway, and are usually made to fit a specialized downhill boot. Cross country bindings must, in contrast, be light weight, allow freedom of foot movement for walking movements, and can usually be fitted to a wide variety of footwear, especially soft boots.

The Army's requirement very definitely calls for a binding that will be effective in both categories. The soldier must have a binding that will fit a relatively soft combat-hiking boot, will

allow freedom of foot movement for his long cross country excursions with a heavy backpack, and yet can be secured sufficiently well to allow him to make reasonable downhill runs.

Only one binding has been found that does the job well and will fit any boot that has just a slight welt overhang. It is the Ramy-Securus ski mountaineering binding, made in Europe. This investigator has used it for years in the high mountains. It was tested in New England's White Mountains in the winter, on the alpine glaciers of the central St. Elias Mountains, and on the 17,600 foot summit plateau of Mt. Logan. It performed well in all environments, and with several types of boots of varying shapes and sizes. It was the only binding available that converted well from mode to mode. In the cross country configuration it was easy to walk freely and comfortably; in the downhill configuration there was good control. And, unlike the old "bear trap", this binding has adjustable safety toe release, especially necessary if skiing in rough terrain with a heavy backpack.

Type tested:

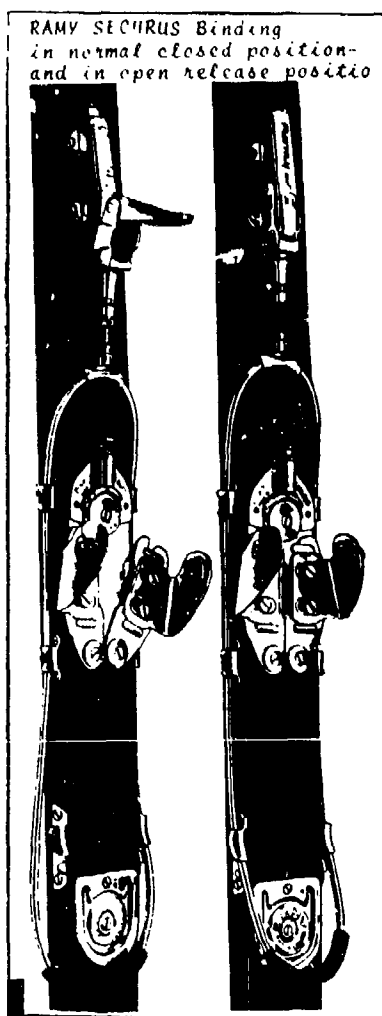
Ramy Securus ski mountaineering binding. Price: \$18.95. European made; available from Eastern Mountain Sports, 1041 Commonwealth Ave., Boston, Mass., and other American suppliers.

Ramy Securus ski mountaineering binding

Catalog description:

"An outstanding ski-mountaineering binding with downhill attachments. Safety-cable front throw. Leaves on either side of toe iron explode for safety release under severe torque. This is heavier hardware and will not fit the narrower skis. Fits any touring or mountain-

earing boot. Three sizes: small, medium and large."



Commendable features:

1. Fits any shape mountaineering, hiking or ski boot that has at least a slight welt overhang. Toe leaves adjust for either round or box toe.
2. Adjustable-tension safety break-away feature.
3. Cable clamps down for downhill skiing, releases for cross country skiing.

4. Cable tension completely adjustable.
5. Most versatile ski binding investigated. Most others are primarily specialized single-purpose bindings. Ramy Securus operates ideally in all modes.

Shortcomings:

1. Will fit only wide skis, of at least 65 mm width. This should be no problem with the Army, unless a new narrow ski is adopted.

Recommendations:

Army should adopt a binding similar to the Ramy Securus. Perhaps an American manufacturer can be located who will make the binding under contract.

Snowshoe bindings

For many generations leather bindings have been the standard for attachment of boots to snowshoes in North America. The designs took many shapes and forms, some better than others, but leather remained the basic material and worked rather well in spite of several innate shortcomings. These included: (1) the inevitable stretch of leather with use, necessitating re-tightening of the binding from time to time during use, and (2) freezing and stiffening of leather in cold temperatures, especially if the leather was wet first.

Recently, new materials have been introduced which have all the advantages of the old leather bindings, but none of the shortcomings. The most accepted material is neoprene-coated nylon, which remains perfectly flexible in coldest temperatures, does not stretch at all, and is essentially waterproof.

Of several designs used over the years, the only acceptable

commercial binding design is the "Howe" style, in its various slightly-modified forms. The EMS binding tested this summer, and used for several years on Mt. Logan, has proved itself almost indestructable (aside from normal wear) and, once properly adjusted, stays on the boot without slippage.

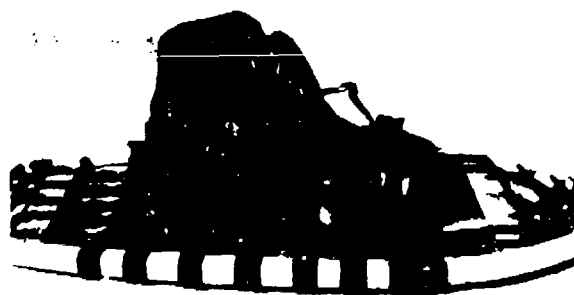
Type tested:

Special neoprene binding. Price: \$10.50 per pair. Eastern Mountain Sports, Inc., 1041 Commonwealth Ave., Boston, Mass.

Special neoprene binding

Catalog description:

"A binding made of strong neoprene laminated on either side of nylon cloth stripping - will not stretch as will leather when wet. Malleable, easy to operate at very cold temperatures. Do not ice up. Has "Howe" type overflap that insures even the softest boot will not work free and slide fore and aft. Complete lateral control of snowshoes with no slippage even with a soft boot."



Commendable features:

1. Does not stretch, even with hard use.
2. Waterproof
3. Will not stiffen or freeze up in cold temperatures.
4. Modified "Howe" design fits boot well and does not allow slippage once properly adjusted.
5. Will not deteriorate with age.

Shortcomings:

None

Recommendations:

Army should adopt "howe" style binding of neoprene coated nylon material, utilizing heavy-duty buckles and rivets throughout. These can be bought "off the shelf" or manufactured under contract.

Climbing boots

Natick expressed a desire for us to evaluate a new boot similar to that which will be made specially for the Army by the Chippewa Shoe Co. The model is the Chippewa 990 with special closed cell foam liner. We contacted Mr. Vincent Cinquegrana at Chippewa, who informed us that no 990s had yet been produced, as they were still in the experimental stage. There were no boots of the new design available for evaluation, so we asked that chippewa send us a pair of their regular climbing boots, of a design closest to that of the 990, to be evaluated for general quality of manufacture, and comfort. Mr. Cinquegrana immediately shipped us a pair of mountaineering boots (stock no. 52800E06GR SP) in a large enough size that the boots could be tested with felt inner liners under cold conditions.

The boots were used by two climbers on separate occasions, while making the ascents of two peaks in the central St. Elias Mountains. Both climbers reported the boots to be warm, comfortable, quite adequate for general snow and glacier climbing, and apparently well made. The boots showed no tendency to come apart under the rugged conditions to which they were exposed; however, we recognize that two ascents, no matter how rugged, are not enough to completely test a boot. This is especially true since we had only a substitute design to work with.

We recommend that the Army proceed with the proposed boot design, which appears to be a good principle, and then expose the boot design to rigorous testing, such as could be accomplished on the Mt. Logan program of the Arctic Institute, at high altitude, beginning in the summer of 1973.

Gaiters

Gaiters come in all sizes and shapes, and have numerous methods of attachment and closure. For the recreational mountaineer the type that has become most popular in recent years is the high gaiter, with a zipper, snap, or lace closure. This type is preferred because of its ability to be put on over boots, without taking them off. For the soldier, however, it is unnecessarily complex and bulky, and a better type is a simple pull-over gaiter, with no complex attachment or closure system. This type is simple, inexpensive, yet completely effective. It's height should be about 11 inches; a lower gaiter is not recommended. This height is ample for the soldier without being wasteful of material or packed bulk. It's simplicity makes it nearly foolproof and breakproof, and it

is light and packs small. It should be waterproof and have instep laces.

Types tested:

(1) EMS high gaiters. Price: \$9.50. Eastern Mountain Sports, Inc., 1041 Commonwealth Ave., Boston, Mass.

(2) Elastic high gaiters. Price: \$3.50. Once available from Eastern Mountain Sports and others, these are now difficult to find from any supplier due to lack of demand.

EMS high gaiters

Catalog description:



"These gaiters stop just below the knee. A wide bellows opening allows pull-on over boots and is then laced up firmly to conform to the shape of the leg. Lace system is as follows: two sets of eyelets on the top and bottom; in between are alternating eyelets and hooks. Nylon cord lock at top of lacing. This provides a simple, fast system of attachment and adjustment even with glove on. Held down by replaceable nylon cord. Made of waterproof, coated 6 oz. nylon duck. In red and blue."

Commendable features:

1. Long 16" length gives greatest protection, and keeps pants from pulling out.
2. Lace-up arrangement makes it possible to put on gaiters without removing boots.
3. Waterproof.
4. Instep laces keep gaiter from riding up leg.

Shortcomings:

1. Complex lace-up arrangement allows more to go wrong or break. Not

really necessary, as gaiters can be easily put on before boots, since they would nearly always be worn from the beginning of a day.

2. 16" height really more than is necessary for the soldier. Only useful in very steep technical ice climbing, where it is possible to kick ones self high on the leg with crampons.

3. Bulky packed size.

Elastic high gaiters

Description:

"Simple pull-over gaiter, with elastic at top and bottom and at top of ankle. Instep lace attached to two eyelets keep gaiters from riding up leg. Made of waterproof coated nylon."



Commendable features:

1. Simplest arrangement (no snaps, zippers, hooks, laces, etc., to break or tangle). Easily put on before boots in morning.
2. Elastic arrangement very effective; gaiters stay up well in all conditions.
3. Instep laces keep gaiter from riding up leg.
4. Waterproof
5. Small packed size; can easily slip in pocket when not in use.
6. 11 inch height ideal; high enough to keep pants from pulling out

(which shorter $5\frac{1}{2}$ inch are not) and protect legs well in normal use.

Shortcomings:

1. Cannot be put on over boots; they must first be removed.

Recommendations:

Army should adopt the 11 inch elastic high gaiter. Though once commonly available off-the-shelf, they may have to be manufactured under contract. Model adopted should have elastic at top and bottom, and at at least one other point, preferably just above the boot top. Grommets at both sides on the bottom will allow attachment of replaceable instep laces.

Two man tents

During the last five years the Arctic Institute has conducted a field research program at 17,600 feet on Mt. Logan, necessitating top quality equipment for a harsh environment. Several types of tents have been used there at one time or another, in various sizes. In the two man size, the only tents that have proven strong enough to withstand the extremely high winds (sometimes over 100 mph) were well guyed A-frame tents and Bishop's Ultimate external frame tents. The best A-frame tent used was the North Face St. Elias Tent, and the external frame models were Bishop's Ultimate Expedition Tents.

These tents were used in extremes of climate that included: (1) winds up to 130 mph for a duration of 10 days, with blowing snow, (2) temperatures down to -39°F. , (3) extremely high insolation (solar radiation) values, that at one time exceeded the theoretical maximum for outer space, due to the high albedo of snow and the presence of reflective surfaces on the slopes surrounding camp, (4) driving rain, and (5) melting snow surfaces beneath the tents.

These tents were again tested this summer, as well as a new free-standing external frame tent developed by the U.S. Army Land Warfare Laboratory, Aberdeen. All tents are available with frost liners, but our tests and experience dictate that they are unnecessary, and even a nuisance, in a two man tent. They add to the weight of the package, quickly become heavier as they become saturated with frost and moisture (they never have a chance to dry properly in the field, as they are packed and carried every day), and subtract from the available space in the tent. We have completely abandoned the use of frost liners in small tents, and have not discovered any appreciable drawbacks.

The Bishop tent has inverted-T shaped entrances, and the North Face an inverted-V. Both are very efficient; however, the "V" allows better partial ventilation in a blowing snow storm, as the entrance may be partly opened from the top. The inverted-T can only be opened from the bottom, allowing ground-drifting snow to enter. This can be simply corrected on the inverted-T by employing a two-way zipper on the vertical section. We have added this modification to our tents, with excellent results. Another small improvement that may be added to any tent is the inclusion of small pockets on either sidewall, inside. These allow small objects to be stored without being on the floor, in the way.

Guying of all tents is necessary in windy conditions, and proper guying is essential to prevent ripping of tent fabric or bending of tent poles. The best method is to use bungee cord in all guys; this allows instantaneous shock-loading, caused by high wind gusts, to be adequately damped. Large diameter bungee (3/8" - 1/2") should be used in main guys; 1/4" is adequate in side pull-

outs and minor guys.

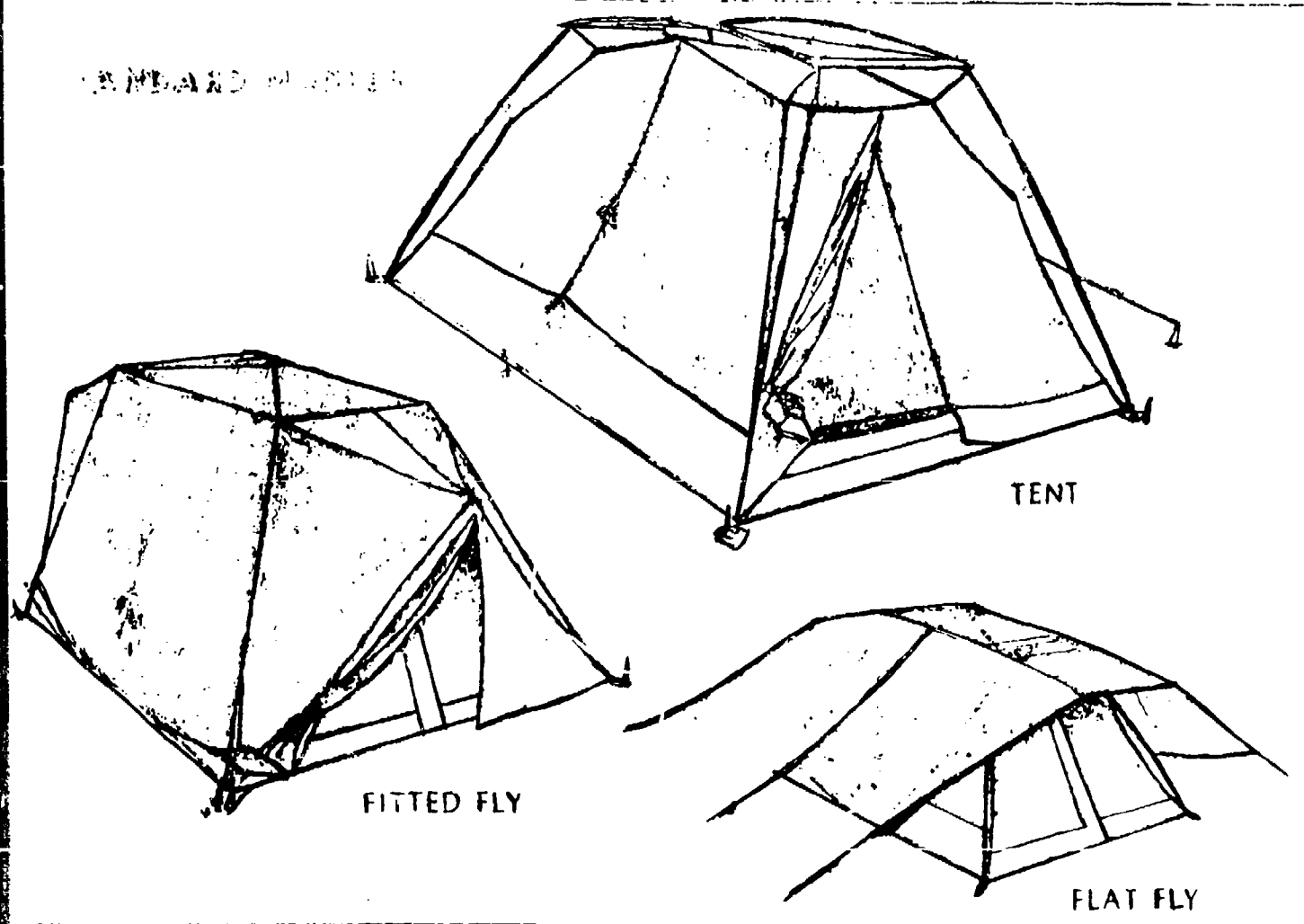
Types tested:

(1) Bishop's Ultimate Expedition two man tent. Price: tent and fly \$191.50; frost liner \$18.00. Bishop's Ultimate Outdoor Equipment, 6804 Millwood Rd., Bethesda, Md.

(2) North Face St. Elias tent. Price: \$155.00. The North Face, P.O. Box 2399, Berkeley, Calif.

(3) U.S.A.L.W.L. 1 - 2 man experimental tent U.S. Army Land Warfare Laboratory, Aberdeen Proving Grounds, Aberdeen, Md.

Bishop's Ultimate Expedition two man tent



Catalog description:

"Light weight, high quality tents for the climber, backpacker, and discriminating outdoorsman. Exo-skeletal Blanchard-designed frame. Nearly vertical walls. Many sophisticated features. Same basic tent used on American Everest Expedition."

Commendable features:

1. Free standing external frame - no guying needed when not in windy area.
2. Rip-stop ($3\frac{1}{2}$ oz.) nylon fabric extremely strong, yet light. Withstood winds of 130 mph for several days without ripping.
3. Not subject to rot or mildew damage.
4. Nylon fabric does not burn (though it does melt in flame or high heat).
5. Nylon zippers work exceptionally well, do not freeze up, do not require lubrication.
6. Has complete entrances at both ends, backed by mosquito netting, making entrance and exit very convenient, and safer in case of combat, fire, or other emergency.
7. Modified box shape very efficient and comfortable; troops can sit upright inside (rather than bowed over as in A-frame tents).
8. 5' x 7' floor quite roomy for two.
9. Inverted-T zippered entrances very efficeint, even in stromy conditions. With the advent of nylon zippers, this design is far superior to the old tunnel entrance, which was necessary for use during cold and snow, because of freeze-up of metal zippers. For the soldier, especially, tunnel entrances are a hazard, as they catch on protuberances such as weapons.

10. Waterproof floor, extending well up sides, is very effiecient.
11. Breathable tent - waterproof fly combination excellent. Keeps rain out of tent without the dangers inherent in a waterproof tent, such as suffocation, insensible moisture buildup, etc.

Shortcomings:

1. External frame adds additional weight to tent.
2. External frame poles can get lost if improper care is exercised. Tent will not pitch properly without all poles. (We lessen this danger by carrying an extra pole - they are all interchangeable).

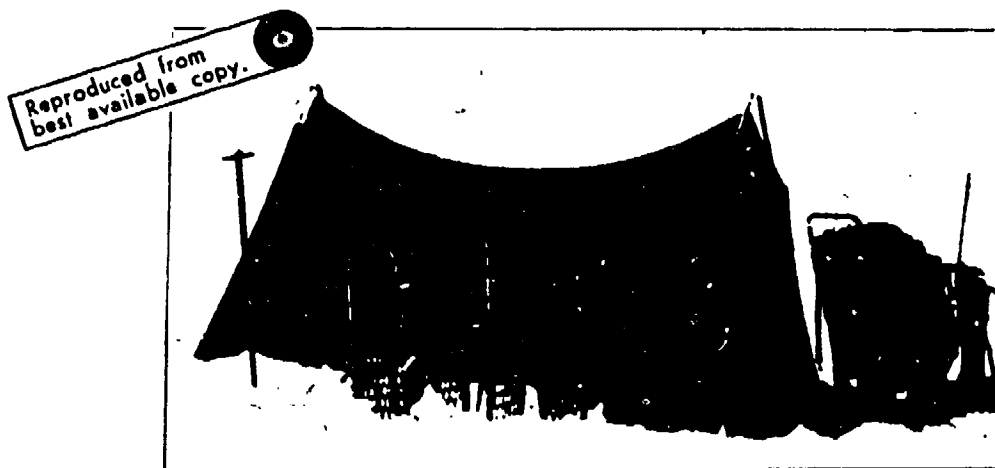
North Face St. Elias tent

Catalog description:

"A tent for high mountain use must be designed to prevent cooling by convection (movement of air). A windproof outer shell is not sufficient if it is pitched so loosely that the tent flaps violently in a wind and stirs up air inside. The advantage of the North Face tent over other high altitude tents is its nearly perfect catenary cut which allows every panel and seam to be pulled taut. Wind flutter is eliminated.

The St. Elias tent is a super mountain tent equipped for winter expeditionary work. The entire 56" by 96" floor space is available since the lower 18" of the sidewall is nearly vertical and the same waterproof fabric as the floor. The tent is pitched with a set of two 56" A-poles, providing 50" of height at either end. A full-size door is sewn to the floor at the front of the tent and fastened up each side by nylon coil zippers. All entrances and vents are mosquito netted. The rear has a tunnel entrance with

drawstring closure. For expedition use, two tents may be joined together by tying the tunnels together. The tent is also equipped with a detachable frost liner and snow flaps on all four sides. Tested with excellent results on Mt. Logan."



Commendable features:

1. Light weight.
2. Rip-stop nylon fabric very strong, yet light.
3. Not subject to rot or mildew damage.
4. Nylon material does not burn (though it does melt in flame or high heat.)
5. Nylon zippers work exceptionally well, do not freeze up, and need no lubrication.
6. Entrances at both ends.
7. Waterproof floor, extending well up sides, very efficient.
8. 56" x 96" floor roomy for two.
9. Breathable tent - waterproof fly combination excellent. Keeps rain out of tent without dangers inherent in waterproof tent, such as suffocation, insensible moisture buildup, etc.

Shortcomings:

1. Slanted walls of A-frame forces sitting occupants to lean over uncomfortably, unlike box shape of Bishop's.
2. Tent must always be guyed, even in windless areas.
3. Pole sections of A-frame can be lost (though this is not as serious as it is with a Bishop's).

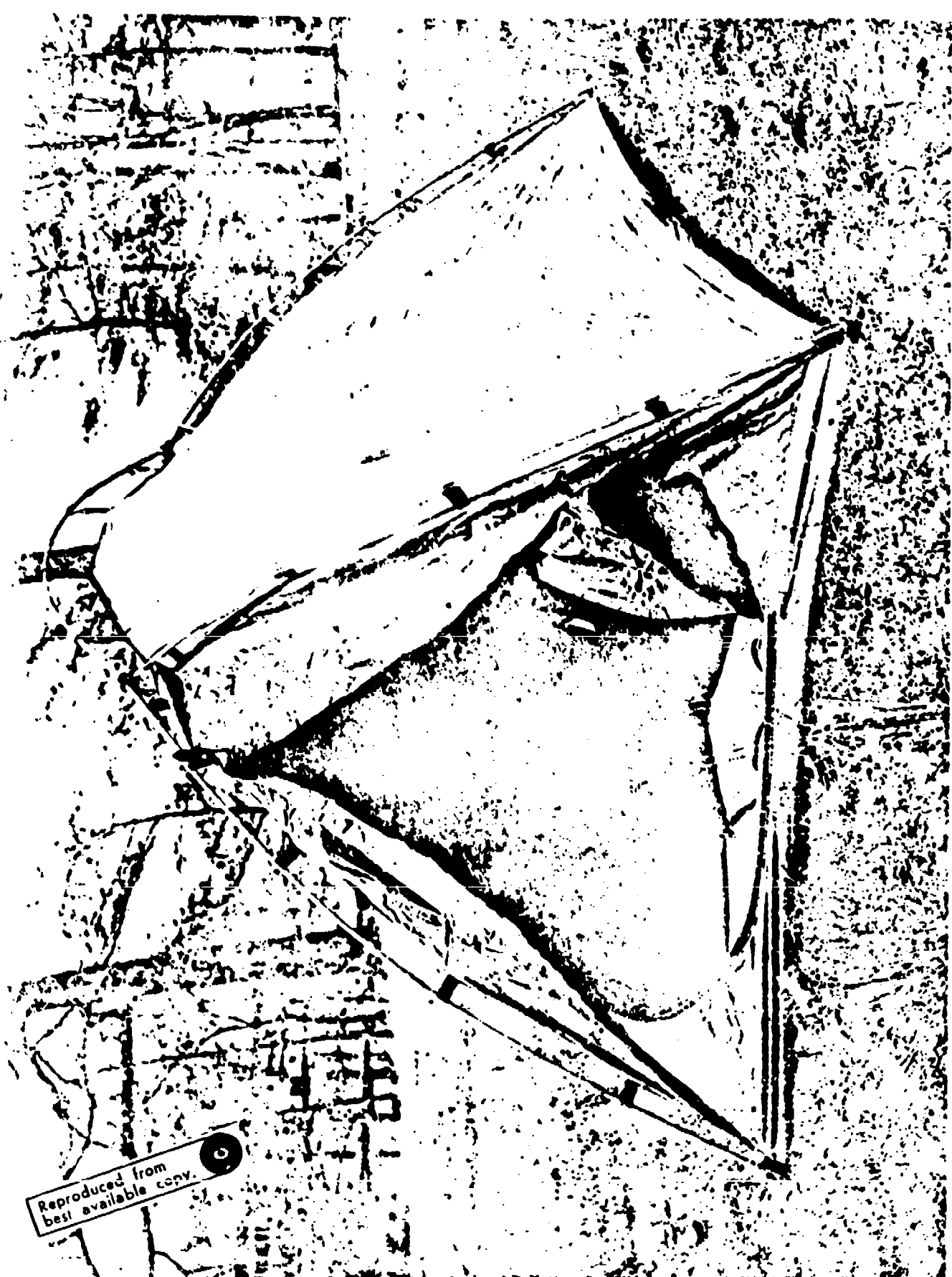
U.S.A.L.W.L. experimental two man tent

Description:

"A two-man tent developed by the U.S. Army Land Warfare Laboratory is supported by an external fiber glass frame, freestanding, and can be erected by one man within 2 minutes. The frame is integrated into the basic tent fabric which precludes the possibility of losing components. The basic tent, including the frame, weighs 4.5 pounds, has a front and rear entrance with a screen, provides 30 square feet of unobstructed floor space and incorporates a built-in ground cloth. A "zip-in panel", provided in the floor, is for use in arctic environments. The packaged configuration measures 13 inches long and 6 inches in diameter. A sunshade and/or liner is available for extreme temperature conditions."

Commendable features:

1. Light weight, and small packed size.
2. Integrated package, precluding loss of parts.
3. Nylon material (light weight, and not subject to rot and mildew damage).
4. Nylon zippers (where used) are very efficient. Do not require lubrication, do not freeze up and break in cold, do not stick to exposed flesh in cold.



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5. Mosquito netting at entrances.
6. Entrances at both ends.
7. Free standing external framework allows quicker set-up and break-down, and allows movement of tent without striking.
8. Fiberglass poles, which are subject to permanent bending as are aluminum poles.
9. Quick set up and striking times.
10. Waterproof material, obviating need for separate fly. (See, however, Shortcoming No. 8).
11. Good comprehensive assembly instructions.
12. Built in waterproof floor.
13. Good door design - "C" shape - allows efficient partial ventilation at top.

Shortcomings:

1. Poles not easy to assemble, due to their interconnection.
2. Tent hard to pack once struck, due to fact that interconnected poles must be aligned (a tricky job) before being packed in tent bag.
3. End canopies do not stay attached. They fall off in slight winds.
4. Frost liner not effective enough to warrant the amount of inside space taken up. Liner droops badly inside, and takes almost half of the available space (already small).
5. Inside room barely adequate for two soldiers (if the frost liner is left out). Walls droop somewhat, limiting inside space even further. Side pullout stays should be provided.
6. A-shape not as useful as box shape of Bishop's tent, because of sloping inside walls.

7. Metal zippers (where used) are no good. They freeze up and break in cold, stick to exposed flesh in cold, and require occasional lubrication. Large (at least #7) nylon zippers should be used throughout.

8. Waterproof tent fabric throughout - though a good idea basically, two problems arise due to the lack of material breathability: (1) water vapor from breathing, cooking, etc., causes moisture to accumulate in the tent. This causes the soldier's clothing and equipment to remain damp (especially if camped for extended periods in the same place). This invites mildewing of clothing, and rusting of weapons and equipment. Since the material does not breathe, the only ventilation is through the doors. Sealing the tent off in cold then becomes dangerous. In cold weather, the soldier will close all doors tightly, allowing only a little air to enter through the closed zippers. If the tent should become somewhat covered in a snow storm, this too can become sealed off sufficiently to cause suffocation. There has been adequate documentation of this danger in several mountaineering fatalities.

9. Poles joined by internal springs and cables will probably have a high breakage rate. It might be better to have the poles joined by internal bungee cords.

Recommendations:

Army should adopt either the Bishop's Ultimate design or the U.S.A.L.W.L. design, with above-mentioned modifications.

Space blankets

Natick Laboratories has indicated that tests on metalized reflector blankets have been discouraging, but somewhat inconclusive:

the expensive laminate of polyethylene, aluminum, and fiberglass has shown itself ineffective in retaining body warmth through reflection of radiated heat, whereas the cheap aluminized mylar variety has appeared to work better. These results were based on instrumented tests of the products, and we were asked to try them from a purely subjective viewpoint: do they keep one warm or not.

Three types were evaluated in the field: the two mentioned above, and a bivouac sack made of the laminated material. The results seem to corroborate Army results, but are still somewhat inconclusive for the laminate blanket.

Types tested:

(1) Rescue blanket. Price: \$3.00. Thermos Division, King-Seeley Thermos Co., Norwich, Conn.

(2) Sportsman Space blanket. Price: \$8.00. Norton Co., Metalized Products Division., 37 East St., Winchester, Mass.

Rescue blanket

Catalog description:

"A waterproof aluminized sheet of mylar which, when wrapped around a person, provides an effective wind barrier and stops virtually all radiative heat loss. Measures 56" x 84". Remains flexible at below zero temperatures. Packs to 2" x 4" x 1½". Weighs 2 oz."



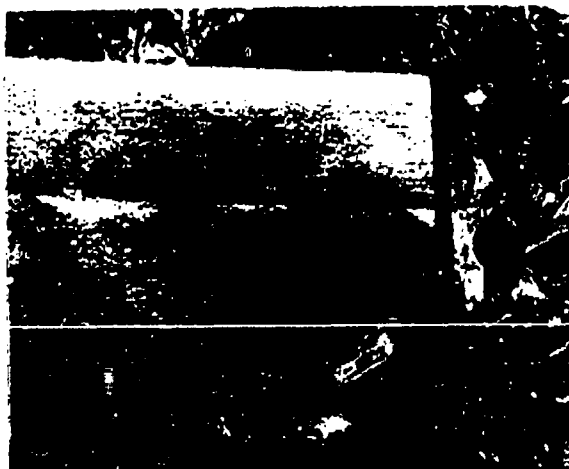
This product was tested during a bivouac atop a 7,500 foot mountain in the Chugach Range of southern Alaska. The temperature dropped below 20°F. with a clear sky (very high radiation loss). In order to best test the effectiveness, the investigator allowed himself to become somewhat chilled (he was wearing only a light jacket and light boots) and his feet somewhat numbed, before putting on the blanket. At this point he covered himself with the metalized sheet and noted any changes in comfort.

With this product the results were quick and impressive; the investigator found himself warmed within 20 minutes, and his feet quickly returned to full feeling and eventual full warmth. This model blanket appears to be truly effective and a very useful adjunct to any rescue or bivouac kit.

Sportsman Space blanket

Catalog description:

"A heavier durable version of the reflector blanket. Multiple laminate of polyethylene, aluminum and fiberglass make a sturdy waterproof tarp or groundcover. Grommets in each corner. Comes with plastic carrying case. Dimensions are 84" x 56". Folded size: 1" x 9" x 10". Weight: 12 oz. Same reflective and retentive heat abilities with one side reflective aluminum color, the other side blue."



This product was tested at 9,800 feet in the central St. Elias Mountains, on a high glacier plateau. The temperature dropped to about 20°F., but the sky was partly cloudy, preventing complete radiation cooling. This may have been a contributing factor to the results of the test.

The investigator allowed himself to become somewhat chilled before putting on the blanket (he was clothed in a light jacket and light mukluks). At this point he covered himself with the laminate, and noted any changes in comfort. After an hour, he had concluded that there was no more change in comfort than would be afforded by a plain tarp sheet, and that he was still chilled and getting colder. The investigator, though disappointed with the test, feels that conditions were not ideal for the evaluation, since the sky was partly cloudy, inhibiting radiation cooling. The major cooling of his body during the test may have been through conduction and/or convection, which the blanket makes no claim to correct. Further subjective tests are required.

Aluminized bivouac sack

This was an experimental model of a bivouac sack made by the Eastern Mountain Sports, Inc., Boston, Mass, constructed of the same material as the Sportsman Space Blanket discussed above, but in the shape of a completely closeable sack. This model was tested on the same night as the test mentioned above, by another investigator. He felt that the aluminized sack was more efficient than the current un-coated model, and managed to sleep in relative comfort most of the night, though he did give it up because of chill about 4 am. We feel that this test was also somewhat inconclusive, due to the poor conditions of radiation cooling.

Recommendations:

It appears that the aluminized mylar Rescue Blanket is very effective, whereas the laminate Space Blanket is questionable. We recommend that the Army adopt the aluminized mylar method for equipment requiring reflective retention of radiated heat.

Mechanical rope ascenders

Most rope ascending devices have been manufactured in Europe over the years, and it is only recently that a model was introduced in the United States. This is the Gibbs ascender, and it compares favorably with the best European model, the Jumar. These are the two types evaluated in this report. Other European models, especially the Hiebeler, are considered somewhat dangerous and/or less effective than the Jumar, and were not given serious consideration.

The Jumar, long the favorite in the mountaineering world, is easily used in a swift ascent of ropes of various sizes. But, though we did not experience it, there have been reports of Jumars slipping on wet or frozen ropes.

The Gibbs ascender, attached to the legs with a simple harness, can make a rope ascent very swift, and no hands are needed to manipulate the ascender, though they are still necessary to maintain balance. They work well on wet and icy ropes, having a more positive pressure on the rope than do Jumars. There is, however, a problem in that they can fall back when pressure is released, if not used with a leg harness. This difficulty could be corrected with a spring attachment modification.

Types tested:

(1) Jumar ascenders. Price: \$32.00 pair. European made; available

from several U.S. suppliers.

(2) Gibbs ascenders. Price: with spring wire \$7.25 ea.; with quick release pin \$8.50 ea. Gibbs Products, 854 Padley St., Salt Lake City, Utah.

Jumar ascenders

Catalog description:

"Perhaps the best known of all the mechanical ascenders, these Swiss-designed devices are somewhat heavier than the Hieblers but do work better on wet or icy ropes. A pivoting tooth gate provides the gripping surface with safety flange preventing accidental unclipping. A hand grip is built into the body. Weight is 15 oz. a pair."



Commendable features:

1. Positive attachment; will not pull off rope until trigger is released.
2. Loop handles protect hands from abrasion against rock face when ascending a cliff.

3. Stays in place on rope even when no pressure is applied, because of constant spring pressure against the rope.
4. Works well on different size ropes (1/4", 3/8", 7/16").

Shortcomings:

1. Heavy to carry.
2. Has been known to slip on wet or icy ropes.
3. Very expensive.

Gibbs ascenders

GIBBS ASCENDERS

Each Ascender is tested to 1000 pounds. Its smooth rounded teeth produce little or no rope damage. Especially applicable to equipment haulage, group ascents, fixed rope and rescue operations. Operates on icy or muddy ropes.



ASCENDERS with spring wire \$7.25
ASCENDERS with quick release pin \$9.50
Include 25¢ postage per ascender / 50¢ airmail

ROPE / SLING / CARABINERS
20% DISCOUNT ON ORDERS
of \$65. OR MORE.
SEND FOR A CATALOGUE TO:

GIBBS PRODUCTS
854 PADLEY STREET
SALT LAKE CITY, UTAH 84108

Commendable features:

1. Lightweight and small.
2. Positive attachment; will not come off rope until pin is pulled.
3. Very simple mechanism; easy to install on rope.
4. Can be attached to legs with a simple harness, leaving hands free except for balance.
5. Works well on wet and icy ropes.

Shortcomings:

1. Can slip down rope when pressure is released, unless tied to leg harness.
2. Comes into two pieces when detached, allowing possible loss of a part (the two parts could be wired or tied together).

Recommendations:

Army should contract for manufacture of Gibbs type ascender, but with modifications that would: (1) place constant spring pressure against teeth on rope, as in Jumar, preventing ascender from slipping back when pressure is released. (2) place a tie-wire between the two detached parts, obviating loss of parts.

Rescue pulleys

Many rescue pulleys are available on the mountaineering market today, and they are all pretty much alike (and acceptable), except for one major entry: SMC makes a simple nylon wheel that fits on a standard carabiner, whereas all other models have a nylon wheel held in an aluminum bracket. At first look, this new simpler version seems commendable, but tests showed that rope abrasion occurs with this model when used against a rock face. The pulley rests against the rock, and severe rope abrasion occurs as the rope moves through the pulley wheel. This is prevented in models with aluminum side brackets.

Types tested:

(1) Pulleydolt 2. Price: \$4.25. The Dolt Hut, Box 5579, Santa Monica, Cal. (As this is written, Dolt has gone out of business, but the pulley he made is very similar to others available on the commercial market).

(2) SMC nylon carabiner pulley. Price: \$0.89. Seattle Manufacturing Co., Seattle, Washington.

Pulleydolt 2

Catalog description:

"Exceptionally strong and smoothly finished, these pulleys are very useful for crevasse rescue, hauling loads, etc. Nylon pulley wheel will accept ropes up to 12 mm. Model 2 has a somewhat heavier wide flange that gives good protection to the rope."



Commendable features:

1. Operates smoothly, with nylon wheel.
2. Wide side brackets protect rope from abrasion against rock faces.

Shortcomings:

None

SMC nylon carabiner pulley

Catalog description:

"Slip onto standard oval carabiner and may be used for crevasse rescue, lifting haul sacks, and so on. Several carabiner with pulleys may be grouped like a block and tackle to achieve considerable mechanical advantage. Weighs 0.4 oz."



Commendable features:

1. Small and lightweight.
2. Operates smoothly with nylon wheel.
3. Pulley axle is carabiner itself, with large diameter, potentially lifting heavier loads.

Shortcomings:

1. Pulley has no protective side brackets to prevent rope abrasion against rock face.

Recommendations:

Army should adopt pulley design similar to Pulleydolt 2 (there are several manufacturers making a similar pulley), with a nylon wheel and protective side brackets.

Carabiners

Since the days of the old Army steel oval carabiner, myriad types, sizes, shapes, and materials have been used in carabiner design, first by a host of European manufacturers and finally by a growing number of U.S. makers. Fortunately, as with most other mountaineering gear, the American makers benefitted from the years of experience of the foreigners and came up with top quality equipment. Aluminum, due to its lightness and corrosion resistance, replaced steel as the basic material as modern technology improved its strength and durability. Though some still feel that the steel carabiner may be somewhat more durable for some applications (ie. where resistance to rope abrasion is critical), this investigator finds the point to be insignificant when weighed against the advantages of aluminum. Comments in the following report refer to design, rather than material, and apply to either steel or aluminum.

Screw locks very definitely have their place, and can be used with any style of carabiner. It has always been this climbers rule to have one or two locking types along for specific purposes, such as pulley systems, carabiner rappels, rescue tie-ups, coupling sleds together or to vehicles, etc. Whatever type of carabiner the Army adopts should be manufactured both with and without screw locks.

Types tested:

(1) Chouinard carabiner. Price: \$3.50. Chouinard Equipment, P.O. Box 150, Ventura, Cal.

(2) SMC oval carabiner. Price: \$2.00. Seattle Manufacturing Co., Seattle, Wash.

Chouinard carabiner

Catalog description:

"This is probably the finest carabiner available. The body is drop-forged from high-strength aluminum alloy and finely finished. The gate operates smoothly, and the hinge and catch pins are strong and well set. The minor axis strength is somewhat greater than in previous models, and the smaller end of the carabiner has been enlarged, enabling it to accept two ropes and several carabiners and etriers. Smoother corner radii enhance the handling characteristics and reduce etrier shift in direct-aid climbing. The Chouinard carabiner is virtually essential for direct-aid climbing, as the gate will open under body weight. A small bulge above the gate facilitates clipping-in when the reach is long and awkward. Maximum dimensions are 4 by 2 $\frac{1}{4}$ in. Weight is 2 $\frac{1}{2}$ oz. Rated strength is over 4000 lbs."



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Commendable features:

1. D-shape provides highest strength - over 4000 lbs.
2. Gate will open under tension (300 lbs test).
3. Asymmetric shape makes gate-opening end obvious.
4. Good minor axis strength (1900 lbs test).

Shortcomings:

1. D-shape will not allow fit of brake bar.

SMC oval carabiner

Catalog description:

"The frame and gate are a high strength aluminum alloy and internal parts are all stainless steel. Gate action is smooth and firm.

Each SMC carabiner is individually tested for this important feature. On all models the gate will open with a 200 lb load on the frame, and an 11 mm climbing rope will pass freely through the gate opening with two aid sling carabiners clipped in. Corners and edges are smoothly rounded and will not snag the rope. Average breaking strength is 2969 lbs; minimum breaking strength is about 2800 lbs. Bright aluminum finish. Weight 2 oz."



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Commendable features:

1. Gate will open under tension (275 lbs test).
2. Allows fit of brake bar.

Shortcomings:

1. Lower strength (about 2800 lbs).
2. Lower minor axis strength (1500 lbs test).
3. Symmetrical shape prevents gate-opening end from being obvious.

Recommendations:

Army should adopt aluminum carabiner, of the asymmetrical D-shape. These could be made under contract to SMC, who has recently come out with a D-shape carabiner of its own (not quite as strong as Chouinard, but quite adequate), which was not available in time for tests. These should be made in both plain and screw-lock types.

Pitons - rock

One of the sweeping changes in piton design in the past decade has been the almost complete conversion, at least in the U.S.,

from soft malleable carbon steel to hard chrome molybdenum steel. The basic reason for the change was the fact that soft pitons were badly deformed during removal, limiting their useful life to but a few placements. But a very important side-effect of the change was a drastically improved holding power in rock. This last is the most important consideration for the Army, since pitons are usually left in place by troops. With very few exceptions (ie. soft or crumbly rock) chrome-moly steel develops a much higher tension when driven, because it does not deform to the shape of the crack, resulting in a very high holding power. Tests of properly driven Chouinard Lost Arrows indicated breaking strengths over 7,000 lbs, and a pull-out holding power (pull along the axis) above 4,000 lbs.

With the increased inherent strength of the new metals, and with new eye designs that have emerged, welded rings have been completely abandoned as the point of carabiner attachment. There were far too many recorded incidents of ring failure due to poor welds - essentially undetectable by the climber. Piton eyes in chrome-moly exhibit very high strength, and tests on Lost Arrows have shown that dynamic loads of over 7,000 lbs are required to break the eye.

There are many good manufacturers (and designs) available on the market today, but the one that has gained greatest respect and acceptance among climbers is Chouinard Equipment of Ventura, Cal. It was his introduction of chrome-moly that started the revolution in piton design, and he has continually upgraded and improved his quality and the state of the art. Chouinard pitons were chosen for our tests against some of the still-available European soft malleable steel pitons.

It is this investigator's opinion that, with the development of stronger chrome-moly steel, new piton shapes and designs should be adopted by the Army. The old vertical and wafer pitons can rotate too easily, a disadvantage obviated by placing a horizontal piton in a vertical crack, where the 90° eye prevents rotation. With the new steels, the old objection of torque on the eye is no longer tenable. For these reasons we chose four sizes in chrome-moly steel which we consider to represent a complete selection useful for climbing all but the most specialized routes.

Types tested:

(1) Chrome molybdenum steel:

Chouinard Lost Arrow, short-thin (5/32" x 1 7/8"). 2 oz.

Chouinard Lost Arrow, long-medium (1/4" x 3 5/16"). 3 5/16 oz.

Chouinard Standard Angle (3/4" x 5 3/4"). 3 1/2 oz.

Chouinard Large Angle (1 1/2" x 6"). 7 oz.

Chouinard Equipment, P.O.Box 150, Ventura, Cal.

(2) Malleable carbon steel: (similar sizes to old Army pitons)

Cassin blade with ring (wafer)(1/4" x 1"). 1 5/8 oz.

Stubai vertical spear (1/2" x 3 1/2"). 2 3/4 oz.

Cassin horizontal blade (1/2" x 3 1/2"). 4 1/8 oz.

Stubai angle with ring (3/4" x 5 1/2"). 3 oz.

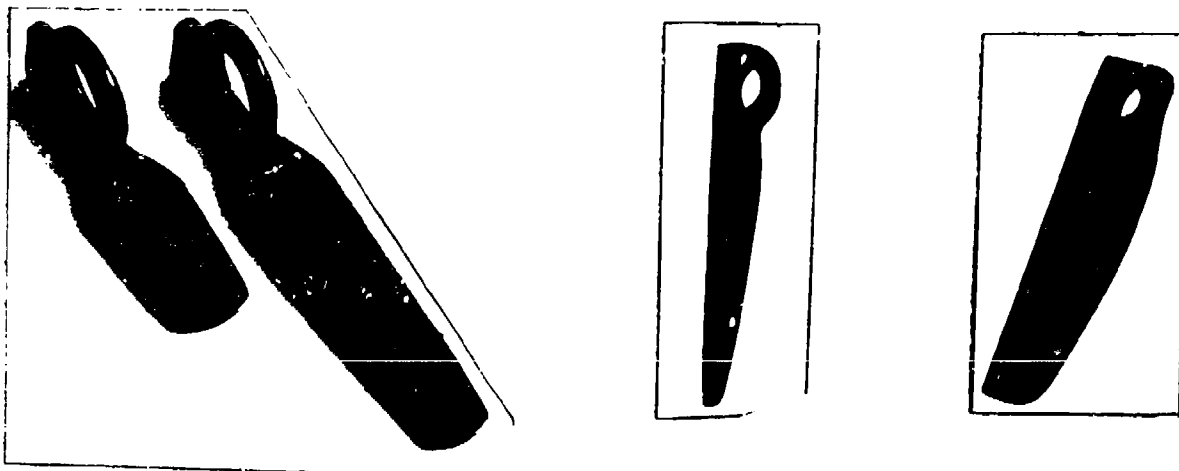
Chouinard chrome-molybdenum steel pitons

Catalog description:

"Lost Arrows - horizontal pitons incorporating economy of material and high strength. Excellent quality chrome molybdenum steel pitons, sized to fit nearly every shape of crack, and well finished. Consistent quality and reliability are made possible through the use

of forging dies and expert hand blacksmithing. They represent the lightest design possible for a given blade size, yet are tough enough to withstand repeated usage. Most Chouinard pitons are now being cadmium plated to help control corrosion.

The angle pitons - have exceptional holding power; yet when not overdriven they are easy to remove, and retain long service life. Because of the crack size most frequently encountered, the 3/4" angle has become the standard angle piton of the American climber. The larger angles are of consecutively larger sizes for wide angle cracks. The 1 1/2" angle is riveted closed for greater strength, holding power, ease of removal, and endurance. All angles are made of aircraft quality alloy steel, and heat treated for optimum toughness."



Commendable features:

1. Very high holding power (in excess of 4,000 lbs).
2. Very high breaking strength (Lost Arrows over 7,000 lbs; angles over 5,000 lbs).

3. Reuseable up to a hundred times without serious deformation.
4. Very high eye breaking strength (Lost Arrows over 7,000 lbs).
5. Cadmium plated to control corrosion.

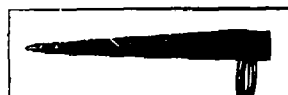
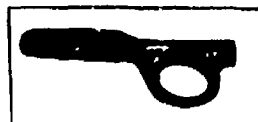
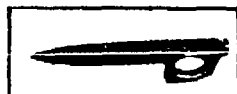
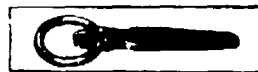
Shortcomings:

1. More expensive than malleable steel pitons.

Malleable carbon steel pitons

Catalog description:

"Some climbers feel that in soft limestone, the soft steel piton which bends to follow a crooked channel will be safer than the alloy piton which will crack if bent over 45°."



Commendable features:

1. More rust resistant than chrome-moly steel.
2. Deforms to follow crooked-channel cracks in soft rock.
3. Very inexpensive.

Shortcomings:

1. Lower holding power than chrome-moly steel (under 1,500 lbs).

2. Not reuseable more than a few times - deforms badly.
3. Low eye breaking strength; ring-eyes are undependable in weld quality.

Recommendations:

Army should adopt chrome-molybdenum steel pitons, in the short-thin, long-medium, standard angle, and large angle sizes (see Types tested for specific size details). These can be manufactured under contract by Chouinard Equipment of Seattle Manufacturing co.

Pitons - ice

For years all climbers used drive-in steel rods, tubes, and combinations for protection on steep ice climbs. They provided little real protection, being more of a psychological assistance than physical, unless the danger was minimal anyway. At the beginning of the last decade Marwa and others, in Europe, designed cork-screw shaped ice pitons (affectionately nicknamed "coat hangers" by ice climbers) which were touted as being the safest thing since the womb, only to be proven relatively unsafe later in the decade.

Several manufacturers took the basic design of the screw-in ice piton and improved upon it, and today there are several that are the safest yet designed. In our opinion the safest of these is, by far, the Salewa tubular ice screw. We tested it in eastern U.S. water ice, in Alaskan hard glacier ice, and in high altitude hard firm conditions, and found it ideal for all situations except soft firm and snow (for which snow should be used anyway).

A re-designed coat-hanger type of screw was also tested and, though not quite as safe as the Salewa tubular screw, is far advanced over the older designs and is much more convenient than the Salewa.

Of the solid-rod types of screws, we strongly preferred the Charlet model.

Types tested:

(1) Salewa tubular ice screw. Prices: 6½" \$5.00; 12½" \$5.40.

European made; available from most U.S. suppliers.

(2) Charlet ice screw. Price: \$3.50. European made; available from most U.S. suppliers.

Salewa tubular ice screw

Catalog description:

"This ice screw has virtually replaced everything else on the market. As a thick-walled, tubular screw with raised threads of square cross-section along its lower length, this screw has exceptional resistance to shearing through ice or snow. Offset eye avoids possibility of displacement due to direct pull. Cadmium plated to prevent rust and to reflect solar radiation."

Commendable features:

1. Strongest, safest ice screw yet designed. Hollow tube fills with ice and freezes in place.
2. Easy placement (start with hammer, then screw in).
3. Easy removal (just screw out).
4. Does not melt loose as easily as other models.
5. Light weight aluminum.

Shortcomings:

1. Difficult to re-use for a while after removal, as ice core in hollow tube is difficult to remove until it melts free.

Charlet ice screw

Catalog description:

"This ice screw is a much improved version of the old "coat hanger" variety. The threads are deeper and the shank is much stronger. A striking anvil is built into the screw so that it can be started with a hammer. This type of screw displaces less ice than do the tube types and is preferred for use in water and other hard ices."



Commendable features:

1. Best "coat hanger" design yet developed; very strong (though not as strong as Salewa tube).
2. Easy to place (start with hammer, then screw in).
3. Easy to remove (just screw out).
4. Easy to re-use immediately after removal.

Shortcomings:

1. Not quite as strong as Salewa.
2. Melts out quicker than Salewa.

Recommendations:

Army should adopt 6½" length tubular ice screw of Salewa design. Should also adopt 12½" length if more than one size is contemplated.

Snow anchors

The ice axe, long the primary method of anchoring and belaying on a snow surface, is still often used for that purpose, and is somewhat safer with the new metal-shafted axes than was previously true. But even now, if strains of more than 2-300 lbs are exerted on an ice axe anchor in snow, it will fail. This is clearly unacceptable, and new snow anchor designs have begun to appear in the mountaineering world. Of these the best appears to be the fluke snow anchor, in which a shovel-shaped piece of aluminum is inserted in the snow, angled toward the expected strain. Attached to the fluke is a steel cable, connected to a critical point which assures that any strain will force the fluke even deeper into the snow, making the anchor even stronger.

We tried fluke anchors on several steep snow climbs in the St. Elias Mountains, at altitudes ranging from 10,000 to 19,000 feet. At the higher altitudes, especially on exposed ridges, the snow is often replaced by very friable rime. Even here the fluke worked well, though it was not as safe as in snow. But no other anchor held at all in rime.

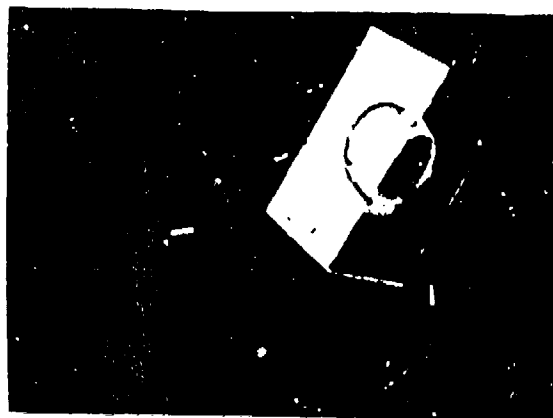
Type tested:

Fluke snow anchor. Price: \$6.00. The Ski Hut, 1615 University Ave., Berkeley, Cal.

Fluke snow anchor

Catalog description:

"Angled aluminum plate with steel cable loop. Provides more security than ice axe belays. Self-adjusting in all directions."



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Commendable features:

1. Strongest snow anchor yet designed.
2. Relatively fail-safe; strain drives fluke deeper in snow, increasing strength.
3. The only anchor known that holds in friable rime (though not as well as in snow, and only if rime is deep enough).
4. Lightweight aluminum.

Shortcomings:

None.

Recommendations:

Army should adopt a fluke snow anchor. It can be bought "off-the-shelf" or made under contract.

Piton hammers

This investigator has used dozens of piton hammers in his experience, and has long-since come to the conclusion that wooden handles are not the best answer. Wood is not as strong as metal or fiberglass (a hammer head lost on a long climb, due to breakage of the wooden handle, nearly caused a disaster), and does not age well, due to internal drying and cracking. This last factor is very important to the Army, where equipment may remain in the supply system for years.

One of the best hammers ever made was the CMI all-metal hammer, but these are no longer available because CMI went out of business recently. But a new hammer on the market, which seems to have all the excellent qualities of the old CMI, is the Forrest Hammer, built in the same general design as the CMI, but with a fiberglass handle. This hammer was tested against the best available wooden handled hammer - the Chouinard.

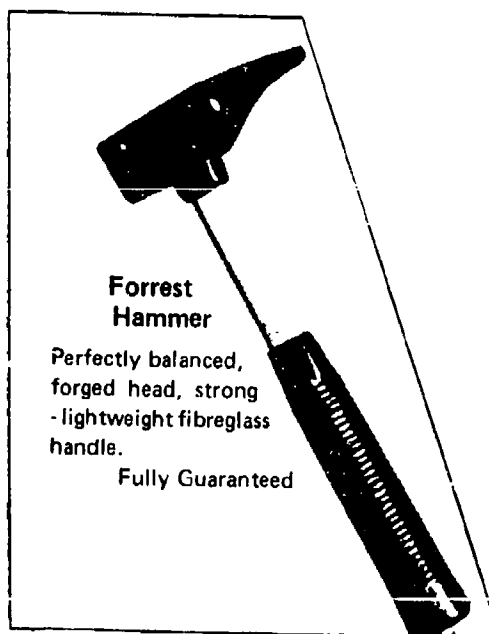
Types tested:

- (1) Forrest hammer. Price: \$16.00. Forrest Mountaineering, Box 7083, Denver, Colo.
- (2) Chouinard Yosemite hammer. Price: \$14.00. Chouinard Equipment, Box 150, Ventura, Cal.

Forrest hammer

Catalog description:

"Perfectly balanced, forged head, strong - lightweight fiberglass handle. Fully guaranteed."



Commendable features:

1. Well balanced design makes piton driving efficient and easy.
2. Blunt pick aids in piton removal.
3. Carabiner hole allows easier removal of pitons in hard-to-get-at places. Does not weaken head strength.
4. Rubber grip gives positive non-slip grip.
5. Shaft will not weaken or dry out with age.

Shortcomings:

None.

Chouinard Yosemite hammer

Catalog description:

"An exceptionally well-designed and constructed hammer which features an American hickory handle and a finely-tooled head of well thought out design. The head is of alloy steel with a blunt pick end for removing pitons in awkward places. The hammer is exceptional for its balance and feel. Each is provided with an easily relaceable nylon web shoulder sling."



Commendable features:

1. Well balanced design for efficient piton driving.
2. Blunt pick aids in piton removal.
3. Hickory wooden handle best wood available (but not as good as fiberglass).

Shortcomings:

1. Wooden handle can dry out and crack with age, leading to breakage. This is an important factor in the Army's supply system, where items may remain for years.
2. No carabiner hole.
3. Wooden handle grip not as good as rubber.

Recommendations:

Army should adopt the Forrest hammer design. This can be bought "off-the-shelf" or made under contract.

Crampons

The Army has long been in need of a new crampon design, as the old model had a high incidence of breakage and was hard to fit properly to any but a few, due to lack of adjustability. Though adjustable crampons are a compromise that inevitably is less than perfect, there are now designs available that are quite satisfactory. Two such were evaluated under varying conditions of hard water ice, glacier ice, hard firn, and snow. These were: the Chouinard crampon and the Simond Grepon adjustable crampon. Each proved well designed and made, but somewhat specialized: the Chouinard was ideal for serious steep technical ice climbing, but was far from ideal for general snow and glacier travel. The Simond was perfect for snow work and glacier travel, but poor on steep ice. The Army, of

course, is more concerned with those conditions in which the Simond proved ideal.

Adjustability with both types of crampons was good. The Chouinard crampon can be adjusted to fit any boot perfectly; the Simond can be well fitted to regular boots, but is difficult to fit to very large boots (such as the Korean boot and the White boot) without modification. The modification, however, is simple, and could be designed into the crampon in such a way that any size boot could be fitted satisfactorily. It consists of a simple tie-bar about $1\frac{1}{2}$ " long, across the front of the crampon, where it normally hinges for adjustability.

Types tested:

(1) Chouinard adjustable crampons. Price: \$35.00. Chouinard Equipment, Box 150, Ventura, Cal.

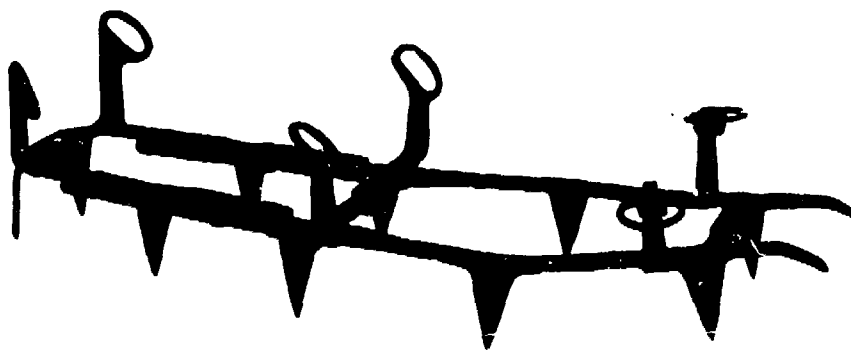
(2) Simond Grepon adjustable crampons. Price: \$24.95. European made; available from Recreational Equipment, Inc., 1525 11th Ave., Seattle, Wash.

Chouinard adjustable crampons

Catalog description:

"The Chouinard crampon is a hingeless fully adjustable 12-point crampon. The rigid design provides stiffness throughout for unexcelled point penetration on technical ice and security on rock. It is adjustable in both length and width to provide a superb fit on boot sizes 7 to 14, and also sizes 5 to 6 with slight modification. The point length is $1\frac{1}{4}$ " for use on both snow and ice courses and the points are aligned on the edge of the sole for efficient utilization of small rugosities on the slopes. The front points are wide

and specially curved for maximum penetration in hard ice and for minimal shearing action on snow or granular ice. The crampons are manufactured from aircraft quality alloy steel for low temperature toughness and are guaranteed against breakage. Frustration-free attachment is assured by the limited-travel rings which cannot flop to the inside. Weight 1 lb 9 oz."



Commendable features:

1. Adjusts perfectly to any size or shape boot.
2. Perfect for steep technical ice climbing, due to stiffness from lack of hinge.
3. Chrome molybdenum steel, very strong.
4. Strap-attachment ring design is such that rings cannot fall inside, under the boot.
5. Short points give better balance on ice (but give less grip in firn and snow).
6. Front points make possible "front-pointing" on steep ice.

Shortcomings:

1. Cannot be used with soft soled boots, such as Korean boot or

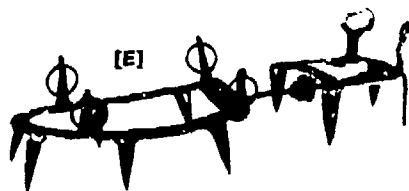
White boot (breakage occurs due to lack of hinge action).

2. Short points do not bite well in steep snow and firn.
3. Parallel alignment of points prevents good bite in snow.
4. Lack of hinge makes long-period walking, such as on galciers, tedious and exhausting.
5. Front points dangerous when fatigued (one kicks ones self in the shin).
6. Numerous set screws must be periodically checked for looseness.

Simond Grepon adjustable crampons

Catalog description:

"A 10 point crampon, adjustable for length and width, the Grepon will fit several sizes of shoes. Made of chrome-nickel steel, cadmium plated, with reinforced ribs and $1\frac{1}{2}$ " long points. Rings for strapping. Weight $1\frac{3}{4}$ lbs."



Commendable features:

1. Adjustable in length and width to fit all regular boots (can be simply modified to fit Korean boots and White boots).
2. Has hinge action, allowing soft soled boots to be used, and making glacier travel and snow climbing more comfortable.
3. Long points ($1\frac{1}{2}$ ") give excellent bite in snow and firn.
4. No front points with which to kick ones self (they are not necessary for Army use anyway).

Shortcomings:

1. Rings can fall inside, under boot, interfering with strap-up.

Recommendations:

Army should adopt a crampon similar to the Simond Grepon, which could be manufactured under contract in this country, with certain modifications:

1. Front tie-bar to allow fit of larger boots, such as Korean boot and White boot.
2. Strap attachment rings should be made in the Chouinard manner, preventing rings from falling over inside.
3. Crampons should be made of chrome molybdenum steel for strength.

Crampon harnesses

As in snowshoe harnesses, the best harness material on the market today is neoprene-coated nylon. Without question, this is the only material that should be considered for crampon harnesses. The only variable, then, is the harness design.

The old Army crampon harness, besides having the drawbacks of leather (which stretches, freezes and stiffens in cold, and is subject to rot with time), also suffered from some design deficiencies. Though very quick and easy to put on and take off - a very important feature - the harness allowed the foot to slip forward when there was forward pressure. This could occur even in normal walking, but was especially common when a climber attempted to kick steps in a snow slope, a frequent occurrence even when wearing crampons. This inevitably led to loss of balance at least, or loosening and loss of the crampon at worst.

The best commercial arrangement we have found is a system of two straps per crampon, riveted on to prevent loss. The rear strap attaches around the ankle, and the front strap over the instep and toes, each being secured separately. This system works well, and prevents forward slippage of the foot, even in soft Korean or White boots. With these very soft boots, the far front cross-over strap can be placed down in front of the toe, instead of over it, giving better security and freedom from slippage.

Type tested:

Neoprene-nylon crampon binding. Price: \$4.95. Eastern Mountain Sports, 1041 Commonwealth Ave., Boston, Mass.

Neoprene-nylon crampon binding

Catalog description:

"Excellent two piece crampon straps made of neoprene-coated nylon. Will not stretch. Comes in 36 and 44 inch lengths. 5/8 inch thick. Order in sets of 4 (two for each toe and two for each heel)."



Commendable features:

1. Neoprene-nylon will not stretch, freeze up, or stiffen in cold, and is not subject to rot over time.
2. Two-strap arrangement is quick to put on and take off, and adjusts very securely.
3. When properly adjusted, no forward slippage of foot in crampon occurs, even when kicking steps in snow.

Shortcomings:

None.

Crampon non-clog protectors

A constant problem with any make of crampon is the fact that wet snow - a condition quite often encountered - tends to clog and ball up between the points, causing a loss of purchase and balance. For years the only solution was to knock the snow out every few steps with an ice axe, accompanied by loud and long cursing. Recently, Pemberthy of Mountain Safety Research came up with a simple and effective solution to the problem. His non-clog protectors are attached to the bottom of the crampon between the points. Snow does not adhere to the PVC (polyvinyl chloride) material, even when wet.

We tested this product, and a simpler version (a piece of polyethylene plastic bag pushed over the points) and found the principle to work very well. The plastic bag must be replaced often, even several times during a single climb, as it quickly becomes shredded. The Pemberthy protectors last longer, but still have a relatively short life, due to the heavy abrasion they endure, especially in mixed snow and rock terrain.

Type tested:

Mountain Safety Research non-clog protectors. Price: 3 pair \$0.80; 6 pair \$1.40. Mountain Safety Research, 631 South 96th St., Seattle, Wash.

MSR non-clog protectors

Non-clogging PVC Plastic Sheet for Crampons prevents snow from packing in crampons.

Item 83. 3 pair \$0.80. 6 pair \$1.40 ppd.

Give extras to your companions for your safety.

Salewa Crampons, lightweight. Adjustable both length and width for tight fit, which is important.

Send self-addressed envelope for Issue 3 of our newsletter, describing the above.

Mountain Safety Research, Inc.



631 South 96th Street
Seattle, Washington 98107

Commendable features:

1. Very effective at keeping wet snow from clogging and balling between crampon points.
2. Easy to attach.
3. Very inexpensive.

Shortcomings:

1. Short life; must be replaced often.

Climbing ropes

Since the introduction of artificial fibers, especially nylon, into the manufacture of ropes for mountaineering, several design concepts have been utilized, with varying degrees of success. The first, and still popular, type was the laid rope of 3-ply twisted nylon fibers, with a stiff, tight lay pattern. Later, various styles of core-and-sheath (kernmantel) ropes were introduced, then

several varieties of softer braided ropes, and finally combinations of artificial fibers (especially nylon and polypropylene) were manufactured into core-and-sheath lines.

This investigator has used most of them extensively (except for the last, which is a new development of U.S. Army Land Warfare Labs, Aberdeen), and concludes that each has its own special advantages, while none is perfect for all uses. But, whereas the private mountaineer may choose to own several ropes of different construction for specialized purposes, the Army should adopt a single rope type which, though admittedly a compromise, is adequate for all purposes. For reasons enumerated below, we feel that laid gold-line rope is the best general purpose rope available to the Army.

Two other factors to be considered are rope diameter and length. Artificial fibers, especially nylon, now in use for rope construction assure adequate strength in lighter lines, such as 3/8" diameter, but we feel that the use of the ropes in a general supply system, where long term usage by many unassociated individuals occurs, justifies a requirement for a larger diameter. Also, larger ropes handle better, by "filling the hand". For these reasons we recommend 7/16" diameter ropes for Army adoption.

There are many advocates for both 120' and 150' climbing ropes. This investigator began his mountaineering days on 120' lines and found them adequate for many years. But, with the common acceptance of 150' lengths, it soon became apparent that greater efficiency and convenience in climbing resulted from the utilization of the longer length, with only a slight disadvantage in terms of weight. We, after subsequent long usage of the 150' length, highly recom-

mend it for Army adoption.

Types tested:

(1) Plymouth goldline rope. Price: (120' x 7/16") \$20.00. (150' x 7/16") \$25.00. Plymouth Cordage Co., Plymouth, Mass.

(2) Edilrid Perlon rope. Price: (150' x 11 mm) \$44.00. European made; available from most American suppliers.

Plymouth goldline rope

Catalog description:

"This is a high quality continuous filament rope made for mountain climbing, with a tighter than normal lay. It retains over 90% of its strength when wet and has excellent abrasion resistance. Its gold color is easy to see, particularly when climbing on ice or snow. The average breaking strength specified by the manufacturer (7/16" diameter) is 5500 lbs."

Commendable features:

1. Very high strength - 5500 lbs test.
2. Laid rope makes inspection for possible fiber damage easy.
3. Good handling qualities for rock climbing; fair for snow and glacier travel.
4. Good kink resistance.
5. With use, rope develops thin furry layer from surface fraying, which helps protect rope from further damage by fraying.
6. Higher rope strength at knot.

Shortcomings:

1. Laid goldline is heavier (by almost 2 lbs for 150 feet) than equivalent strength kernmantel.
2. In snow and glacier travel, goldline exhibits greater sliding friction resistance on the snow surface.

3. Natural twist causes rotation of free-rappeling climber.
4. Laid rope exhibits "rubber band" effect - elongation under light loads.

Edilrid Perlon rope

Catalog description:

"This rope is of the kernmantel type. In single ropes (11 mm) the kern consists of 15,000 continuous fibers each having a diameter of 0.50 mm (.002 in.). These fibers are combined in three braided units. The multiple unit concept helps to reduce the internal friction developed during a fall. It also causes the rope to be less stiff making it easy to work with, especially when tying knots. The average breaking strength specified by the manufacturer is 5900 lbs."

Commendable features:

1. Very high strength - 5900 lbs test.
2. Very light - almost 2 lbs lighter than equivalent-strength goldline rope.
3. Good handling qualities on snow, glacier, and rock.
4. Sheath cover protects load-carrying core from abrasion.
5. Less "rubber band" effect than goldline rope; yet has equivalent high-impact elongation (which is what protects a falling climber.)
6. Low sliding friction resistance on snow.
7. Nearly straight core fibers prevent rotation of free-rappeling climbers.

Shortcomings:

1. Sheath can hide damage to load-bearing core.

2. Less kink resistance than goldline.
3. Lower strength at knot.
4. Very expensive.

Recommendations:

Army should adopt Plymouth Goldline rope, in 7/16" diameter and 150 foot lengths, for general mountaineering purposes.

Ice axes

Several new metal shafted ice axes have appeared on the market in recent years, in an attempt to replace the wooden shafts, which are unpredictable in strength, never strong enough, and subject to deterioration over time. Along with this change, new head designs have appeared, most of which are better than the old styles, but which are somewhat specialized. Some head designs are preferable for serious steep ice climbing, whereas other designs are necessary for general snow climbing, glacier travel, and self arrest on steep slopes.

We tested two of the new axes, and found them both to be extremely well made, and excellent designs for their specific purposes. These were the MSR Thunderbird axe, designed for the general snow and glacier traveler, and the SMC all-metal axe, specialized for the serious ice climber.

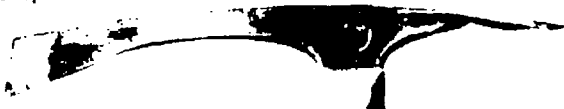
Types tested:

- (1) MSR Thunderbird ice axe. Price: \$13.75. Mountain Safety Research, Inc., 631 South 96th St., Seattle, Wash.
- (2). SMC all-metal ice axe. Price: \$40.00. Seattle Manufacturing Co., Seattle, Wash.

At Last! Strong, All Metal ICE AXES at a moderate price \$13.75, \$12.85 ^{five or more}



EAGLE — Superb for self-arrest on both hard snow and ice. Chop with adze.



THUNDERBIRD — Superb for self-arrest also. Chop with both adze and pick.



PARBAT — Similar to Nanga Parbat of Stubai, Everest of Ralling, and others.

CHROME MOLY steel heads heat-treated to Rc 31-37. High-strength ALUMINUM ALLOY tubular shafts. High-strength spike design, with no ferule joint. Both head and shaft coated with Neoprene-base for grip, heat insulation, and orange color. Light weight, one pound twelve oz. (780 gm) 32.5" length.

Plus packing and postage \$1.00 west of Mississippi, \$1.50 elsewhere. Plus 5% tax in Wash. State only. The quantity price is available to anyone; join with your friends. Any mix of heads and lengths: 22, 26, 29.5, 30.5, 31.5, 32.5, 33.5, 34.5, 35.5, 36.5, 37.5 inches. Supplied with glide ring and wrist strap. Polished heads on special order, \$5.00 extra. Introductory prices, subject to change after May 10.

If not already on our mailing list, send self-addressed stamped long envelope for Issue 4 of our Newsletter describing our work in ice axe testing and design. Send 50¢ without the envelope for issues 1, 2, 3, and 4.

MOUNTAIN SAFETY RESEARCH, INC.

(Dept. S) 631 South 96th Street, Seattle, Washington 98108



Commendable features:

1. Good weight and balance; handles well for snow, glacier, and moderate ice climbing.
2. Wide pick excellent for step chopping in ice; pick does not stick in ice.
3. Excellent for self arrest due to large pick (caught two-man fall on 40° hard ice in tests).
4. Neoprene cover insulates handle well, and provides adequate grip.
5. Has carabiner hole in head.
6. Metal shaft is stronger and longer lasting than wood.

Shortcomings:

1. Should have teeth on bottom of pick to aid in holding pick in

hard firn.

2. Bright orange color (only one available) useless for Army troops; this could easily be changed in contract.

SMC all-metal ice axe

Catalog description:

"The SMC ice axe is a premium grade axe of highest quality, the result of over a year of research and development. The head is drop forged, nickel chrome-moly alloy steel. The handle is tubular aluminum. Made in a wide range of handle lengths, it has the design features necessary for steep technical climbing as well as general snow climbs.

The handle is swaged onto the head under high pressure and permanently bonded with high strength epoxy. Spike and handle are joined in the same manner. Covering material for the handle is tough PVC with good heat insulating characteristics. It has the feel and grip of wood. Color is black, offering good visibility on snow. Glide ring is aluminum and has a blue tubular nylon wrist loop.

Overall lengths available: 21" through 39" in 2" steps.

Weight of 29" axe - $2\frac{1}{4}$ lbs."



Commendable features:

1. Good weight and balance, handles well for serious steep ice.
2. Pick droop follows natural arc of swing, is perfect angle for holding in steep ice in "piolet ancre" position.
3. Reasonably good for self arrest (but not as good as MSR Thunderbird).
4. Has carabiner hole in head.
5. Metal shaft is stronger and longer lasting than wood.
6. Has teeth on under side of pick, to aid in holding pick in ice and hard firn.

Shortcomings:

1. Though excellent for steep ice, and quite good on snow and glacier, it is not quite as good on snow and glacier travel as the MSR Thunderbird.

Recommendations:

Army should adopt metal shafted ice axe of the MSR Thunderbird type, in 30 inch and 36 inch lengths, with wrist straps.

Insulating material - sleeping bags and jackets

Natick Laboratories requested us to evaluate one of the new man made fibers now being produced for outdoor clothing and sleeping bags. The material is Fiberfill 2, manufactured by E.I. Dupont Co., and we obtained two experimental expedition jackets made by Eastern Mountain Sports, Inc., of Boston. We were unable to obtain, in time for the summer's work, sleeping bags filled with Fiberfill 2.

The jackets were used extensively during the summer in the St. Elias Mountains. Two men used them exclusively, in place of their usual down filled jackets. The rest of the party used down

filled gear for comparisons. The Fiberfill 2 jackets were found to be very satisfactory under the conditions encountered, being suprisingly light and warm. Though Fiberfill 2 does not measure up to down for the amount of warmth retained per given weight of material, it proved to be the best artificial insulating material any of us had yet seen or used, and it has certain advantages of its own, particularly where the soldier is concerned. These are enumerated below, where down and Fiberfill 2 are compared.

Types tested:

- (1) Prime white goose down. Available from several suppliers in the United States, but originates from foreign sources.
- (2) Fiberfill 2. E.I. Dupont de Nemours, Inc., Wilmington, Del.

Prime white goose down insulating fill

Commendable features:

1. Lightest weight known for a given insulating value.
2. Very compressible; high-loft equipment can be packed in small containers.

Shortcomings:

1. Very expensive, and becoming increasingly scarce. Available only from foreign sources (though duck down is available domestically).
2. Susceptible to rot and muldew damage in damp conditions.
3. In damp climates, it mats and clumps, losing loft and warmth.
4. Must be carefully cleaned to avoid removing natural oils in down.

Fiberfill 2 insulating fill

Commendable features:

1. Lightest weight artificail fill material for given insulating

value.

2. Reasonably compressible, though not as much as down.
3. Relatively inexpensive, and available in large quantities from domestic manufacturer.
4. Not subject to rot or mildew damage; essentially limitless life; care free.
5. Does not mat or clump in damp conditions, hence loses less warmth that does down.
6. Easy to clean; just wash in machine with any soap or detergent, and tumble dry.

Shortcomings:

1. Heavier than down for given insulating value.
2. Less compressible than down.

Recommendations:

Army should adopt Fiberfill 2 as an insulating fill material for clothing and sleeping bags.

Sleeping pads

Two considerations must be kept firmly in mind when choosing a sleeping pad for a soldier: warmth and comfort. Air mattresses were comfortable enough but, due to internal air circulation causing heat transfer, they were very cold when the temperature dropped. Closed-cell (ensolite, thermobar, volarifoam, etc.) foam sleeping pads are extremely effective in retaining heat but, unless a cumbersome thickness of the incompressible material is used, they are very uncomfortable when used over a hard or rough surface. Open-cell foam (polyurethane, etc.) is much thicker and compressible for an equivalent weight and warmth of closed-cell material, and pro-

vides comfort on hard or rough surfaces.

Some climbers still claim an advantage in rolled size of closed-cell foam, but our experience has shown that the new polyurethane foams compress so effectively that the rolled size is the same for equivalent insulating value. For these reasons, we feel strongly that the thicker open-cell mattress-pad should be adopted by the Army. The soldier, as the general climber, can be effectively immobilized by a series of sleepless nights, and this syndrome is far more potentially dangerous to the Army. Warmth and comfort for the sleeping soldier are as important to him as a good weapon.

Types tested:

(1) Ensolite closed-cell foam. Price: ($\frac{1}{2}$ " x 28" x 84") \$13.20.

Eastern Mountain Sports, Boston, Mass. and other suppliers.

(2) Polyurethane open-cell foam. Price: (2" x 22" x 72") \$14.00.

Eastern Mountain Sports, Inc., 1041 Commonwealth Ave., Boston, Mass., and other suppliers.

Ensolite closed-cell foam

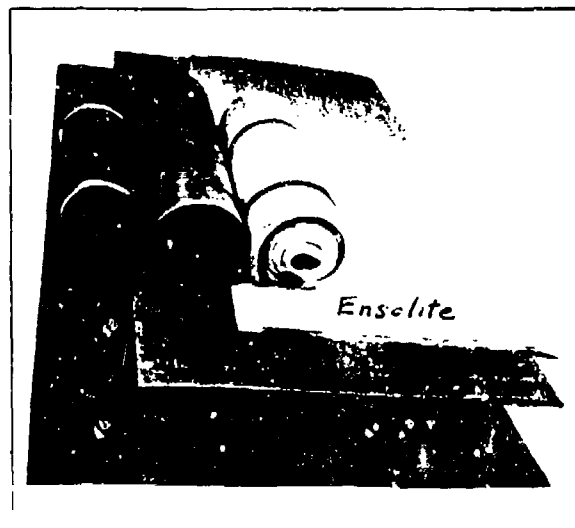
Catalog description:

"A very popular sleeping pad for winter use. With these pads it is possible to sleep on snow or ice and still be relatively comfortable. Compresses relatively little under body weight. It is impermeable (the air cells are not interconnected). Hence this material is a very effective insulator. For sleeping on snow the following rule of thumb might be applied:

1/4" thickness Good to plus 20 degrees F.

3/8" thickness Good to plus 5 degrees F.

1/2" thickness Good to minus 10 degrees F."



Commendable features:

Thinnest foam material for given insulating value.

2. Waterproof material; does not soak through; does not need waterproof shell.

Shortcomings:

1. Becomes stiff and brittle in extreme cold.
2. Relatively incompressible, leading to hard feeling under sleeper.
3. Though very effective insulator, requiring only thin sheet to maintain warmth, this allows irregularities in surface under pad to be felt by sleeper, and causes discomfort and loss of sleep.

Polyurethane open-cell foam

Catalog description:

"Our foam pads are constructed from flexible polyurethane foam sheathed in a two-part nylon, dacron-cotton cover. The bottom of the cover is waterproof, super K-Kote nylon taffeta weighing 2.5 oz/sq. yd. The top is dacron-cotton blend to help dissipate insensible perspiration. All foam pads come with two nylon tie straps and a built-in pleated pillow section. The 72 inch pad is made from 2 inch thick foam."

Commendable features:

1. Thicker pad for given insulating value (2", compared to $\frac{1}{2}$ " for closed-cell) gives much greater padding under sleeper, allowing greater comfort and sounder sleep. Yet compressible material rolls to same size as rolled Ensolite. Material is lighter than Ensolite for a given thickness, so finished pad is comparable in weight. Result: much greater comfort from polyurethane pad of same weight, rolled size, and insulating value as Ensolite.
2. Remains soft and flexible in extreme cold.
3. Tie-straps built in to waterproof shell.

Shortcomings:

1. Material is not waterproof, so must be covered with waterproof shell. This is usually done by making bottom of shell of waterproof coated nylon, while top is of breathable cotton-dacron fabric.

Recommendations:

Army should adopt polyurethane open-cell foam pads, with waterproof or half-waterproof, half-breathable shells. These can be bought "off-the-shelf" or manufactured under contract.

